

## WHAT IS CLAIMED IS:

1. An apparatus for activating an occupant restraint device of a vehicle, said apparatus comprising:
  - 5 a roll condition detector for detecting a roll condition of the vehicle;
  - a lateral acceleration sensor for sensing a lateral acceleration of the vehicle in a width direction of the vehicle;
  - a trip-over determination unit determining whether an
  - 10 anticipated rollover of the vehicle has a pattern of trip-over in response to both the lateral acceleration and the roll condition of the vehicle;
  - a trip-over pattern recognition unit recognizing the pattern of trip-over based on the lateral acceleration of the vehicle, when
  - 15 the anticipated rollover of the vehicle has the pattern of trip-over;
  - a rollover determination criteria unit setting a rollover determination criterion for the vehicle depending on the recognized pattern of trip-over;
  - a rollover determination unit determining whether the
  - 20 vehicle will roll over based on both the roll condition of the vehicle and the rollover determination criterion for the vehicle; and
  - an activation unit activating the occupant restraint device of the vehicle depending on a determined result from said rollover determination unit, the determined result being indicative of that
  - 25 the vehicle will roll over.
2. The apparatus as set forth in claim 1, wherein said

trip-over pattern recognition unit recognizes the pattern of trip-over depending on a parameter selected from a set of parameters indicative of characteristics of the lateral acceleration of the vehicle.

5           3.       The apparatus as set forth in claim 2, wherein the set of parameters indicative of characteristics of the lateral acceleration of the vehicle includes a rate of the lateral acceleration of the vehicle in a rising stage thereof, a maximum value of the lateral acceleration of the vehicle, and a length of duration of the  
10 lateral acceleration of the vehicle.

          4.       The apparatus as set forth in claim 3 further comprising a lateral speed detector for detecting a lateral speed of the vehicle in the width direction of the vehicle, wherein said rollover determination criteria unit sets the rollover determination  
15 criterion for the vehicle based on the detected lateral speed of the vehicle prior to a rise of the lateral acceleration of the vehicle and the recognized pattern of trip-over.

          5.       The apparatus as set forth in claim 4, wherein said lateral speed detector determines the lateral speed of the vehicle  
20 prior to the rise of the lateral acceleration of the vehicle in terms of an amount of kinetic energy of the vehicle subsequent to the rise of the lateral acceleration of the vehicle, the kinetic energy of the vehicle consisting of a translational energy and a rotational energy of the vehicle.

25           6.       The apparatus as set forth in claim 5, wherein said lateral speed detector determines the lateral speed of the vehicle

prior to the rise of the lateral acceleration of the vehicle by further factoring in a potential energy of the vehicle subsequent to the rise of the lateral acceleration of the vehicle, the potential energy of the vehicle corresponding to the roll condition of the vehicle.

5           7.       The apparatus as set forth in claim 6, wherein:

          said roll condition detector further comprises a roll angular rate sensor for sensing a roll angular rate of the vehicle and a roll angle detector for detecting a roll angle of the vehicle;

          said rollover determination unit further comprises a  
10   two-dimensional map on which the roll angle and roll angular rate of the vehicle are used as parameters and a threshold line is set to separate a rollover region and a non-rollover region, and said rollover determination unit determines whether the vehicle will roll over by applying actual values of the roll angle and roll angular rate  
15   of the vehicle to the two-dimensional map thereof; and

          said rollover determination criteria unit sets a rollover determination criterion for the vehicle by adjusting the threshold line on the two-dimensional map of said rollover determination unit.

20           8.       The apparatus as set forth in claim 2, wherein:

          said roll condition detector further comprises a roll angular rate sensor for sensing a roll angular rate of the vehicle and a roll angle detector for detecting a roll angle of the vehicle;

          said rollover determination unit further comprises a  
25   two-dimensional map on which the roll angle and roll angular rate of the vehicle are used as parameters and a threshold line is set to

separate a rollover region and a non-rollover region, and said rollover determination unit determines whether the vehicle will roll over by applying actual values of the roll angle and roll angular rate of the vehicle to the two-dimensional map thereof; and

5           said rollover determination criteria unit sets a rollover determination criterion for the vehicle by adjusting the threshold line on the two-dimensional map of said rollover determination unit.

9.       The apparatus as set forth in claim 1 further  
10       comprising a lateral speed detector for detecting a lateral speed of the vehicle in the width direction of the vehicle, wherein said rollover determination criteria unit sets the rollover determination criterion for the vehicle based on the detected lateral speed of the vehicle prior to a rise of the lateral acceleration of the vehicle and  
15       the recognized pattern of trip-over.

10.       The apparatus as set forth in claim 9, wherein said lateral speed detector determines the lateral speed of the vehicle prior to the rise of the lateral acceleration of the vehicle in terms of an amount of kinetic energy of the vehicle subsequent to the rise of  
20       the lateral acceleration of the vehicle, the kinetic energy of the vehicle consisting of a translational energy and a rotational energy of the vehicle.

11.       The apparatus as set forth in claim 10, wherein said lateral speed detector determines the lateral speed of the vehicle  
25       prior to the rise of the lateral acceleration of the vehicle by further factoring in a potential energy of the vehicle subsequent to the rise

of the lateral acceleration of the vehicle, the potential energy of the vehicle corresponding to the roll condition of the vehicle.

12. The apparatus as set forth in claim 9, wherein:

said roll condition detector further comprises a roll angular  
5 rate sensor for sensing a roll angular rate of the vehicle and a roll angle detector for detecting a roll angle of the vehicle;

said rollover determination unit further comprises a  
two-dimensional map on which the roll angle and roll angular rate  
of the vehicle are used as parameters and a threshold line is set to  
10 separate a rollover region and a non-rollover region, and said rollover determination unit determines whether the vehicle will roll over by applying actual values of the roll angle and roll angular rate of the vehicle to the two-dimensional map thereof; and

said rollover determination criteria unit sets a rollover  
15 determination criterion for the vehicle by adjusting the threshold line on the two-dimensional map of said rollover determination unit.

13. The apparatus as set forth in claim 1, wherein:

said roll condition detector further comprises a roll angular  
20 rate sensor for sensing a roll angular rate of the vehicle and a roll angle detector for detecting a roll angle of the vehicle;

said rollover determination unit further comprises a  
two-dimensional map on which the roll angle and roll angular rate  
of the vehicle are used as parameters and a threshold line is set to  
25 separate a rollover region and a non-rollover region, and said rollover determination unit determines whether the vehicle will roll

over by applying actual values of the roll angle and roll angular rate of the vehicle to the two-dimensional map thereof; and

said rollover determination criteria unit sets a rollover determination criterion for the vehicle by adjusting the threshold  
5 line on the two-dimensional map of said rollover determination unit.

14. The apparatus as set forth in claim 1 further comprising a second rollover determination unit, wherein:

said second rollover determination unit determines whether  
10 the vehicle will roll over based on the roll condition of the vehicle and a rollover determination criterion thereof, when the anticipated rollover of the vehicle has a pattern of non-trip-over; and

said activation unit activates the occupant restraint device  
15 of the vehicle depending on a determined result from said second rollover determination unit, the determined result being indicative of that the vehicle will roll over.

15. An apparatus for activating an occupant restraint device of a vehicle, said apparatus comprising:

20 means for detecting a roll condition of the vehicle;

means for sensing a lateral acceleration of the vehicle in a width direction of the vehicle;

means for determining whether an anticipated rollover of the vehicle has a pattern of trip-over in response to both the lateral  
25 acceleration and the roll condition of the vehicle;

means for recognizing the pattern of trip-over based on the

lateral acceleration of the vehicle, when the anticipated rollover of the vehicle has the pattern of trip-over;

means for setting a rollover determination criterion for the vehicle depending on the recognized pattern of trip-over;

5            rollover determination means for determining whether the vehicle will roll over based on both the roll condition of the vehicle and the rollover determination criterion for the vehicle; and

means for activating the occupant restraint device of the vehicle depending on a determined result from said rollover

10          determination means, the determined result being indicative of that the vehicle will roll over.

16.        A method for activating an occupant restraint device of a vehicle, said method comprising the steps of :

detecting a roll condition of the vehicle;

15           sensing a lateral acceleration of the vehicle in a width direction of the vehicle;

determining whether an anticipated rollover of the vehicle has a pattern of trip-over in response to both the lateral acceleration and the roll condition of the vehicle;

20           recognizing the pattern of trip-over based on the lateral acceleration of the vehicle, when the anticipated rollover of the vehicle has the pattern of trip-over;

setting a rollover determination criterion for the vehicle depending on the recognized pattern of trip-over;

25           determining whether the vehicle will roll over based on both the roll condition of the vehicle and the rollover determination

criterion for the vehicle; and

activating the occupant restraint device of the vehicle depending on a rollover determination result indicative of that the vehicle will roll over.